

## **SECTION 16881**

### **PUBLIC ADDRESS SYSTEM**

#### **PART 1 - GENERAL**

##### **1.1 DESCRIPTION**

- A. This Section specifies designing, furnishing, and installing a complete and operational Public Address System (PA/VMS) at MBTA Station.
- B. System functionality is based on the specifications given and the information shown on the drawings. Actual system performance shall be measured against design performance criteria.
- C. The Station Public Address System installed under this Station Contract shall receive, amplify, and distribute (via loudspeakers), voice announcements originating remotely from the Announcement Control System at OCC and Workstations, and locally from a local microphone station, Station Public Address Computer, and Remote Access Terminals.
- D. The Public Address System installed under this Station Contract shall interface and work with the new ARINC PA/ESS headend hardware and software system installed at 45 High St.
- E. The Contractor is responsible for providing a copy of ARINC's AIM software to run on each station controller unit.
- F. The Contractor shall be responsible for modifying the Authority's existing PA system at 45 High St. to allow the Authority's personnel at the OCC to trigger Public Address messages, both visual and audio, to MBTA stations throughout the system.
- G. The transmission from OCC will be over the MBTA's Wide Area Network. Where the WAN is not available the contractor will provide T1 lease lines. The Contractor shall be responsible for providing interface' connections to and from the designated Main Distribution Frame (MDF) and or the Wide Area Network.
- H. The PA/VMS network shall use TCP/IP protocol.
- I. The Station Public Address System shall be a fully integrated system. The system shall be microprocessor based and shall manage and control all station functions and hardware including microphone page stations and associated queuing, telephone interfaces, distribution of emergency announcements, local announcements, OCC announcements, background music, recorded announcements, pre-recorded and assembled messages, and

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visual display paging.

- J. The Passenger Station Public Address System shall include an Ambient Noise Analysis System that will automatically change the volume level of the Public Address System dependent on the amount of the ambient noise level at the station.
- K. The system shall interface directly via Ethernet to one or more single-faced 2-line electronic signs. Mounting of the electronic signs shall be as indicated on the contract drawings.
- L. Designated Passenger Station Systems shall provide telephone access into the OCC Announcement Control System, which shall allow remote announcements to various Passenger Station PA. Systems or groups of Passenger Station Systems via a secure access pass-code.
- M. The system shall be capable of distributing data and audio from OCC Control System to local audio zones and visual displays. The system shall have the capability to send and receive announcements to and from other station nodes.

## **1.2 PUBLIC ADDRESS HARDWARE PROFILE**

The Contractor shall install all equipment, materials, and cables required to support the station PA/VMS. Installation shall be in accordance with all Contract requirements, approved drawings, and custom commercial practices. Prior to installation of any equipment on MBTA property, Contractor shall bench test and certify that all equipment is in operating condition.

### **1.1 AUDIBILITY/INTELLIGIBILITY CRITERIA**

The acoustic performance of the public address system may need to meet guidelines for fire voice evacuation (EVAC) systems. To meet the guidelines the system has to be audible and intelligible.

The Contractor shall meet the requirements of Audibility and Intelligibility per NFPA 72:1999

- A. Audibility can be quantified by achieving an averaged announcement level of 15db greater than the ambient background noise level (or 5db above the maximum background noise level exceeded for more than 60 seconds).
- B. Intelligibility can be quantified by meeting the Speech Transmission Index (STI) of 0.5 (as referenced in the IEC 60849).

### **1.2 EQUIPMENT CABINET AT THE STATION SHALL CONTAIN THE FOLLOWING DEVICES**

- A. A control cabinet microphone for local "real time" announcements.

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- B. A Public Address Station Controller Unit for remotely controlled “pre-recorded” announcements.
- C. A monitor panel/keyboard for viewing/monitoring of the SCU.
- D. Multi-channel Digital Signal Processor unit which will accept various microphone and line level inputs, provide high quality signal amplification necessary to drive station loudspeakers at desired sound pressure levels.
- E. A xxx watt Dual Channel Amplifier with protocol to allow remote control and monitoring from the OCC. Remote control abilities shall permit adjustments needed to provide high quality signal amplification necessary to drive station loudspeakers at desired sound pressure levels.
- F. Ambient Noise Sensing Module: The Ambient Noise Sensing Module and Level Detector shall be a component of the Audio Processing System.
- G. An Ethernet interface Module
- H. A 4 Port VOIP Gateway to provide live audio over the network
- I. A 24 port Image Switch
- J. A 3 port Router if required.
- K. All Ethernet equipment must be SNMP Managed

## **1.5 QUALITY ASSURANCE**

### **A. Contractor Qualifications**

1. Shall be primarily engaged in supply, installation, and maintenance of commercial duty sound systems.
2. Shall be authorized by the manufacturer of equipment supplied for the supply, installation, and maintenance of that equipment.
3. Shall employ factory-trained personnel for assembly, installation, and maintenance of this system.
4. Shall maintain a service facility stocked with spare parts, service manuals, and test equipment sufficient to efficiently repair this system and its comprising elements.
1. Shall maintain its service facility within 25 miles of Boston.

### **B. Manufacturer Qualifications**

1. A firm whose primary function is to manufacture commercial duty sound

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products.

2. Pre qualifies contractors for supply, installation, and maintenance of products.
3. Furnish support services as follows:
  - a.) Contractor training;
  - b.) Periodic Contractor review for technical performance;
  - c.) Service and maintenance manuals, including schematic information and parts lists;
  - d.) Factory stock of replacement parts;
  - e.) Factory repair service.

#### C. Equipment requirements

1. Shall be standard products employed in similar installations.
2. Shall have been available for installation over a period of two years or more.
3. Shall be shop tested before assembly into system to confirm products meet or exceed manufacturer parameters for:
  - a.) Functional capability and control range;
  - b.) Electrical gain;
  - c.) Self-generated noise;
  - d.) Frequency response;
  - e.) Distortion;
  - f.) Free from RFI, and EMI.
4. Exception: Contractor fabricated assemblies shall be exempted from requirements of 1 and 2 above. Only assemblies specifically designated herein, as "Contractor Fabricated" shall be exempted.
5. Equipment rack and control panel sub-assemblies shall be shop tested before delivery to installation site.

#### D. References

1. National Electrical Code.
2. Massachusetts Electrical Code.
3. EIA/TIA
4. NFPA
5. IEEE

### 1.6 SUBMITTALS

- A. Submit the following to the engineer for approval before commencing acquisition or assembly of materials:

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1. Certification that the installing Contractor maintains a fully equipped service organization within 25 miles of Boston.

2. Bill of materials proposed for this project, to include:

- a.) Item's specification reference number;
- b.) Item's specification description;
- c.) Item's manufacturer and model number;
- d.) Manufacturer descriptive literature for each item.
- e.) Quantity of each item proposed
- f.) Underline all items proposed as alternates to that equipment specified.

B. Contractor shall submit the following before commencing acquisition or assembly of materials:

- 1. AC power requirements for all equipment; Heat generated by all equipment when operating at 10 dB below full rated output, in BTU HRS. Heat dissipation calculations for all equipment installed within equipment case showing rise above ambient temperature.
- 2. Block diagrams showing proposed equipment interconnection
- 3. Proposed rack elevation;
- 4. Details for Contractor fabricated items, to include:
  - a.) Drawings or samples illustrating proposed size, shape, panel layout, color, finish, labeling, and or pertinent characteristics;
  - b.) Electrical schematics and parts list;
  - c.) Technical descriptions of parts comprising fabrication.

C. Contractor shall submit four copies of following information upon completion of installation:

- 1. Functional flow diagrams illustrating component connections, with switches, relays, controls, and cable designations referenced by number;
- 2. Rack elevation;
- 3. Nominal control settings illustrated as pictorial representations of equipment items' control panels.
- 4. Fabrication details, with switches, relays, controls and or devices referenced to functional flow diagram.
- 5. Data describing manufacturer-produced equipment, to include four bound copies of following:

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- a) Manufacturer's descriptive literature;
  - b) Manufacturer's operating manuals;
  - c) Manufacturer's servicing information including schematics and parts lists.
6. System test and measurement data described in this Specification.
7. Proposed mounting methods for loudspeakers and or items of substantial weight;
8. Loudspeaker orientations;
- D. Contractor shall submit an outline of training program that shall meet requirements specified herein. Ten copies of all manuals and literature' along with course syllabus shall be submitted ten days in advance of respective program starting date(s).
- E. The Contractor shall submit an Audibility/Intelligibility system tests for approval to the MBTA.
- F. The Contractor shall submit the Audibility/Intelligibility test results for approval to the MBTA. This report shall be submitted for MBTA approval prior to commencing acquisition or assembly of the materials.

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## **1.7 TRAINING**

- A. Contractor shall provide a minimum of three days of training to 75 MBTA designated employees in testing, installation, and repair of PAS station equipment. Specific areas of training shall include following: The contractor will provide all training equipment, material and test equipment required to support this training.
1. Use of test equipment;
  2. Adjusting audio levels;
  3. Replacement of Components;
  4. Periodic Maintenance requirements.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Equipment specified herein shall be as manufactured by Crown, Lyle, Shure, Bogen, Cisco, Mulit Tech, Atlas, or approved equal.
- B. Procedures for submitting proposals for Contractor fabricated assemblies are described above.
- C. Loudspeaker Cable shall be one-pair, 16 AWG, copper stranded, nominal O.D. 0.255 inch.
- D. Microphone/Control Cable shall be: six pair, 22 AWG, copper stranded, each pair aluminum polyester foil-shielded with drain wire, overall PVC jacket, and nominal O.D. 0.355 inch.
- E. Cable shall employ identical color-coding throughout system.
- F. Cable types as approved by the Engineer.
- G. The Amplifier shall conform to UL 1480 for speaker circuit line monitoring.

### **2.2 CROWN CTS 1200 DUAL CHANNEL POWER AMPLIFIER**

- A. Rated Output: 600w per channel into 8 ohms
- B. Frequency Response:  $\pm 0.25$  dB. At 1 watt 20Hz to 20KHz
- C. Signal to Noise Ratio (20 Hz to 20 kHz): 105 dB A-weighted.
- D. Total Harmonic Distortion from 20 Hz to 20 kHz: < 0.1%.
- E. Damping Factor: 10 Hz to 100 Hz: > 3000.
- F. Input Impedance (nominal): 10 kilohms balanced, 5 kilohms

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	unbalanced.	
G. Maximum Input Level:	maximum.	+20 dB input compression, +32 dB
H. Load Impedance	ohms	2/4/8/16 ohms, Bridge Mono: 4/8/16
I. Required AC Mains		120V/60 Hz, 230V/50 Hz.
J. Dimensions:		19 in. W x 3.5 in. H x 14.25 in. D.

## 2.3 CROWN DIGITAL SIGNAL PROCESSOR

### DIGITAL SIGNAL PROCESSOR MOD # PS-8810C

- Power Requirements: 100VAC to 240 VAC, 24W nominal
- Data Communication: RS232
- Data Format: Serial, binary, asynchronous
- Data Rate: 38.4K BAUD
- Input Gain Range: +20 dBu to -1 2dBu
- Digital Sampling: 24 bit, 48kHz
- Input Impedance: 20kOhms balanced, 10kohms unbalanced
- Dynamic Range: Greater than 1 00dB (A-weighted, 20 Hz-20KHz)
- Frequency Response: 20Hz-20kHz,  $\pm 0.5$ dB
- Output Impedance: 100 Ohms balanced 50 ohms unbalanced
- Weight: 13 pounds, 4 ounces (6.1 kg)
- Dimensions: 19"W, 16"D, 3.5"H

## 2.4 MULTI TECH, MVP 210 - 4 PORT OR APPROVED EQUIVALENT VOIP GATEWAY

- Number of Trunks 2 or 4 (4 or 8 BRI Channels)
- Signaling TI -CAS/ROBBED bit signaling clear channel
- Connection 1, 2 or 4 RJ.48
- Interface 10/100 Base-T
- Format Ethernet/SNAP
- Power 115v/240V 60 Hz
- Protocols H323, V4, Sip, RTR SMTP
- Bandwidth G.211, G.726, G727 G729 with voice compression
- Management Web browser Windows SNMP
- Dimensions 17.4"w x 1.75"h x 8.75d"

## 2.5 CISCO 2950 SERIES INTELLIGENT ETHERNET SWITCHES

Model number WS-C29850-24

## 2.6 STATION CONTROLLER OR APPROVED EQUIVALENT

- Suntron 2U Rack mount SCU Computer
- Intel P4 4GHZ Processor w/400 MHZ Front Side Bus w/512MB
- 1 Serial 1 Parallel and up to 8 USB Ports

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- 80gb Seagate 7200RPM IDE Hard Drive
- 5.1 Digital Sound Card
- National instruments Digital I/O Adapter
- National Instruments USB to 485 Adapter
- Microsoft Windows XP Professional
- ARINC's AIM CIS PDS and PAC software

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## **2.7 COASTCOM (R25) - 3 PORT Mini Mux with Router or approved equivalent**

- Line Rate 1.544 Mbps
- Framing D4/ESF (selectable)
- Line Code AMI/ B825 (selectable)
- Connector DA15P
- Input Signal DSX-1 from 0db to -26db W/albo
- Output Signal DSX-1w/0, -7.5-15db
- Power 120volts at 60Hz
- Dimensions 12"w x 1"h x 7"d

## **2.8 PTM-6D CROWN PRESSURE ZONE MICROPHONE**

- Operating voltage 12-48 volts phantom power
- Frequency 20 Hz to 20 kHz
- Power sensitivity -43db
- Connector XLRM
- Impedance 240 ohms balanced
- Current drain 1.1ma
- Sound Pressure 150 db SPL/3% THD
- Dimensions 3-in x 2.5-in x .375

## **2.9 CROWN PIP- LITE MODULES**

- Operating voltage 24 volts dc
- Power Dissipation 4.6 watts
- Frequency Response .5db from 20 to 20kHz
- Dynamic Range 110 db from 20 to 2khz
- Impedance 20 kilohms

## **2.10 SHURE UNIDIRECTIONAL MICROPHONE**

## **2.11 LOUDSPEAKERS**

### **Type I Loudspeaker**

- A.** The loudspeaker shall be an Atlas Model C803A (70.7v) or approved equivalent, with line matching transformer.

- Speaker Size 8" diameter
- Power Rating 16 watts RMS
- Frequency Response 70Hz - 15.5 KHz
- Sensitivity 98db peak
- Impedance Nominal 8 ohms
- Cone Material Treated Paper
- Flex Density 10,600 Gauss
- Voice Coil Diameter 1"
- Weight 2.4 lbs.

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## **Type II Loudspeaker**

- B.** The loudspeaker shall be a Electro-Voice 309 Series (70V), or approved equivalent,
- Speaker Size 8.13" d x 3.25"h
  - Power Rating 16 watts RMS
  - Frequency Response 85Hz - 18 KHz
  - Sensitivity 98db peak
  - Impedance Nominal 8 ohms
  - Cone Material Treated Paper
  - Flex Density 10,600 Gauss
  - Voice Coil Diameter 1"
  - Weight 3.3 lbs.
- C.** The low frequency driver shall utilize a metal-alloy cone with deep-anodized surface treatment for rigidity and corrosion resistance. The cone shall provide a heat transfer element for the voice coil under high-power input. Compounded rubber cone surrounds shall be formulated to withstand all-environment installations, including salt spray, ultraviolet light (UV), heat, cold, and constant humidity. The voice coil will be centered via a high gauss, low viscosity magnetic fluid (ferrofluid), which increases the heat transfer rate from the voice coil under long-term high-power use. The magnetic fluid shall prevent corrosion from occurring in the magnet gap.
- D.** The high frequency driver shall utilize an environmentally stable titanium diaphragm. Ferrofluid shall dampen the voice coil and assist in the heat transfer for higher power capability.
- E.** Environmental testing shall ensure long-term operation in any weather. Specifications shall exceed Mil-Std-810E Test Methods for Temperature, Humidity, Ultra-Violet Light, and Salt Spray.
- F.** The mounting bracket shall be designed with multiple angles to facilitate installation in corners or when angulation is required. An integral safety strap mounting point shall be included. The loudspeaker shall rotate, on its axis, a minimum of 180°. The bracket shall be formed from heavy-gauge aluminum (minimum 3mm thick), and finished with a scratch-resistant paint (color-matched to the enclosure).
- G.** The input connectors for 8-ohm and 70-volt systems shall be gold-plated screws with integral clamping washers.
- H.** The Contractor will be required to adapt the speaker, if needed, to the contract drawings with the approval of the MBTA Engineer.

## **Type III Loudspeaker**

- A. The loudspeaker shall be a Bogen Model SPT30A, or approved equivalent,
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reentrant type horn loudspeaker. The frequency response shall be 225Hz to 14kHz. Rated power output shall be 30 watts, RMS continuous. Dispersion shall be 100°. Sound pressure level, measured four feet on axis with 30watt input @ 1000Hz, shall be at least 125dB.

- B. The unit shall incorporate a seven-position weather-sealed switch, to allow matching the loudspeaker to a 25V or 70V constant-voltage line. Power handling capacity shall be adjustable at 70V to 1.8, 3.7, 7.5, 15, or 30 watts, and at 25V to 1.8, 3.7, 7.5, or 15 watts. Impedance shall be adjustable to 2500, 1300, 666, 333, 167, 89, or 45 ohms.
- C. The loudspeaker shall include a self-aligning, field-replaceable diaphragm. Screw terminals shall be provided for connection to the audio line. A plastic cover shall be provided to protect the connectors and impedance selector switch, and provide strain relief for the audio line. An all-purpose mounting bracket shall provide precise positioning in the vertical and horizontal planes with a single adjustment. The bracket shall include banding slots to permit mounting the loudspeaker on beams or pillars. Bracket and loudspeaker shall be finished in textured mocha enamel. The unit shall measure 11" in diameter by 10-1/2"D.

- Power Rating (RMS): 30 watts continuous, 40 watts equalized
- Frequency Response 225Hz to 14kHz
- Impedance: 25/70 volts
- Sound Pressure Level 125dB ~ four feet on axis with 30 watt
- Dispersion: 100 degree
- Dimensions 11' Diameter x 10-1/2"d

- D. Weatherproof Equipment: Where equipment is exposed to the weather, provide items specifically designed and listed for such duty.

## **2.12 EQUIPMENT RACK CONTROL PANEL**

- A. Furnish and install paging selector switch, microphone, microphone and power supply status indicators mounted on equipment rack control panel.
- B. Furnish and install 19" x 5-1/4" x 1/8" aluminum rack mounted panel which meets or exceeds following requirements:
- 1.Labeling -directly engraved and white paint filled.
  - 2.Finish -brush texture and black anodized.
- C. Furnish and install components which meet or exceed following requirements:

1.Barrier Strips -One Cinch-Jones 4-140 and one 8-140, Kulka, Amp, or approved equal.

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2. Switch -1-pole. 4-position rotary: Stackpole 73-1005, Grayhill, Alco, or approved equal.

3. Switch Knob -1-1/2" pointer: Clarostat P-120, Waldon, Alcot or approved equal.

4. Diodes -1 N4001

5. Microphone -panel mounting XLR-3F Receptacle Type: Switchcraft D3F. Cannon, AKG, or approved equal.

6. Microphone - close-talking, hand-held, low impedance, push to talk, with normally shorted microphone element and normally open DC control contacts: Altec D9IP, Electro-Voice, Turner or approved equal.

7. Microphone - right angle cord-mounting Connector XLR-3M type: Switchcraft R3M, Cannon, AKG, or approved equal.

8. DC Status Indicators LED, green, with integral mount: Alco SLD-853G, Waldon, Grayhill, or approved equal.

D. Assembly shall be as follows:

1. Bolt barrier strip to rear of panel.
2. Mount microphone clip with tamperproof hardware.
3. Bolt microphone receptacle to panel.
4. Terminate DC status indicators to 4-140 barrier strip and microphone and DC control wiring to 8-140 barrier strip. Terminate wiring to barrier strips with spade lugs. Solder all other connections

## **2.13 PRIORITY AND MUTING CIRCUIT**

A. Priority and muting circuit shall sense triggering voltage from the Public Address Computer Control Circuits and Equipment Rack Control Panel.

B. Priority and muting circuit shall prioritize audio inputs as determined by the MBTA.

C. In the absence of a page announcement, priority and muting circuit shall:

1. Lift all source lines from mixer inputs
2. Short all mixer input lines;

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3. Reduce all mixer input gains to 60 dB below full output.
- D. In presence of a page announcement, priority and muting circuit shall:
1. Terminate paging source to assigned mixer input;
  2. Lift short from assigned mixer input line;
  3. Restore gain of assigned mixer input channel.
- E. Upon conclusion of a paging announcement, priority and muting circuit shall restore amplifier to idle state.

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## **2.14 AC POWER SUPPLY**

- A.** Conductors - Furnish and install single conductor electrical wires, type THHW, moisture and heat resistant insulation, rated at 600 Vac, with Underwriter's Laboratories (UL) label, and printed throughout entire length, at two-foot intervals, with permanent identifying markers, indicating manufacturer's name, size, type and voltage.
- B.** Raceways - Furnish and install electrical feeders installed in galvanized rigid steel conduit as shown on Contract Drawings.
- C.** Circuit Breakers - Furnish and install non-magnetic, molded case type circuit breakers, rated at 600 Vac, with current rating and number of poles as shown on Contract Drawings.
- D.** Power Distribution Panels - Power will be provided to each equipment case and PA equipment from a MBTA provided Distribution system.
- E.** AC Power Outlets - Furnish and install 2 rack mounted multi-outlet strips providing 120 VAC, 60 Hz power within each equipment case.

## **2.15 EQUIPMENT CASE**

- A.** Furnish and install Public Address equipment housed in an equipment case as specified on the Contract Drawings.
- B.** Furnish and install Public Address equipment case with a thermostatically controlled heater and vent fan. Power to the heater and vent fan to be provided on separate circuits from the power distribution panel
- C.** Power Off and Status Indication Light.
  - 1. Furnish and install a power off and equipment status indication light on station side of each equipment case. Light shall be lighted when power is on.
  - 2. Furnish and install equipment case with a two-inch diameter hole cut in case on side facing station. Furnish and install equipment case with a red Lexan type lens with a gasket or seal to weatherproof hole.
  - 3. Furnish and install equipment case with a 120-volt, low wattage lamp and base mounted inside case behind the lens.
  - 4. Furnish and install lamp wired as indicated on Contract Drawings.
    - a) Cable shall employ identical color-coding throughout system.
    - b) Cable types as approved by Engineer.

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## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Utilize existing conduit as indicated on Contract Drawings. Where conduit is required under this Contract, furnish and install separate conduit for the following:
  - 1. AC Power
  - 2. Control Cable.
- B. Cable Dressing
  - 1. Cross power wiring only at right angles and with loop providing separation of at least six inches.
  - 2. Support lateral wiring to prevent contact with station appurtenances and to prevent stress.
  - 3. Protect connections within junction boxes with waterproof electrical tape.

### **3.2 GROUNDING**

- A. Provide equipment-grounding connections as required. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.
- B. Ground equipment, conductor, and cable shields to eliminate shock hazard and to minimize to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments. Equipment rack ground should be less than 1-ohm from central ground point. Measure, record, and report ground resistance.

### **3.3 TESTING**

- A. Test each device in presence of a manufacturer's representative. Upon completion of test, submit a certified test report to the Engineer.
- B. Any system deficiencies observed under testing shall be noted in certified test report. All deficiencies shall be corrected and system shall be retested. Submit a sequential certified test report to the Engineer.
- C. Test the complete system for Audibility and Intelligibility per NFPA 72:1999 with the Engineer.
- D. Test the complete system in the presence of the Engineer. If any deficiencies

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are observed, correct same as described herein. Submit as-built drawings, maintenance manuals, and spare parts to the Engineer one-week prior to final scheduled testing.

- E. Final Audibility and Intelligibility acceptance testing of Public Address System shall be conducted by the Engineer and Contractor on a date established by the Engineer.

#### **PART 4 - MEASUREMENT AND PAYMENT**

##### **4.1 GENERAL**

- A. Separate measurement and payment will not be made for work required under this Section, but all costs in connection, therefore, will be included in the Contract Lump Sum Price for Item 1650.000 Communication System

##### **4.2 PAYMENT ITEMS**

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>UNIT</u>
1650.000	Communication System	LS

**END OF SECTION**

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